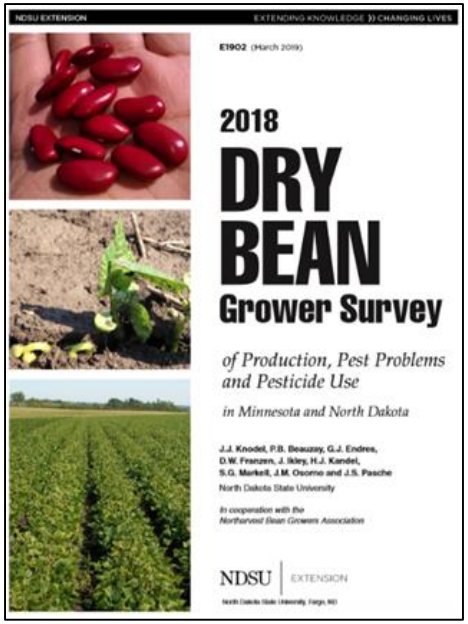
Plant establishment subjects

- **Plant development: review of live plants**
- **Tillage systems**
- **Rye cover crop for pinto bean**
- **Planting date**
- **Pinto bean row spacing by plant population**
- **Ground rolling**

Dry bean **tillage system** reported by Northarvest growers, 2018

(Dry Bean Grower Survey - NDSU Extension and Northarvest Bean Growers Association)



p. 12;
table 14

Tillage system	Acres (%)
Conventional	77
Minimum	14
Strip-till	4
No-till	5

Pinto bean yield among tillage systems, Carrington, 2007 and 2009-12 (5 site-yr)

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STRIP TILL
FOR FIELD CROP PRODUCTION

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WHAT IS STRIP TILL?

The trend among northern Plains farmers is toward using less tillage to produce field crops with more residue left on the soil surface. Strip till is a field tillage system that combines no till and full tillage to produce row crops.

Narrow strips 6 to 12 inches wide are tilled in crop stubble, with the area between the rows left undisturbed. Often, fertilizer is injected into the tilled area during the strip-tilling operation. The tilled strips correspond to planter row widths of the next crop, and seeds are planted directly into the tilled strips.

Strip tilling normally is done in the fall after harvest, but it also can be done in the spring before planting.

ADVANTAGES OF STRIP TILL

- Conserves energy because only part of the soil is tilled
- Reduces soil erosion because most of the soil remains covered with crop residue throughout the year
- Releases less carbon into the atmosphere and maintains higher levels of soil organic matter
- Warms the tilled strips sooner in the spring to promote seed germination and plant emergence
- Conserves soil moisture because most of the soil surface area is covered with crop residue
- Results in crop yields that are similar or higher, compared with other tillage systems
- Reduces expenses by eliminating some primary and secondary tillage

STRIP TILL AND NRCS CONSERVATION INCENTIVES

Strip tillage can be used to qualify for the Natural Resources Conservation Service (NRCS) conservation manage- ment/no-till incentive programs.

To qualify for NRCS no-till incentive programs, a Soil Tillage Intensity Rating (STIR) value of 10 or less is required.

Table 1. STIR values for common tillage operations.

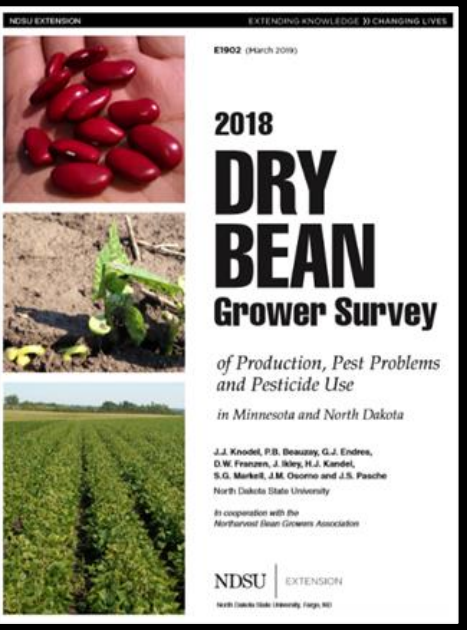
Operation	STIR
No tillage	0
Double-disk opener planter	2.4
Strip till – coulter, 5-inch depth; 8-inch berm	7.7
Strip till – shank, 7-inch depth; 10-inch berm	15
Tandem disk, light finishing	19
Vertical till	20
Field cultivator, 6-to-12-inch sweeps	23
Tandem Disk	32-39
Ripper	33
Chisel, twisted shovel or sweeps	42-49
Moldboard plow	55-65

STIR is a numerical value calculated using RUSLE2, a computer model that predicts long-term average annual erosion by water. This model is based on crop management decisions implemented in a field. The NRCS assigns a numerical value to each tillage operation. STIR values range from 0 to 200, with lower scores indicating reduced soil disturbance.

Other benefits of low STIR values include increased organic matter content of the soil and improved water infiltration rates.

Net search:
'NDSU strip till'

2018 Dry bean grower survey (Northarvest region): Cover crop use

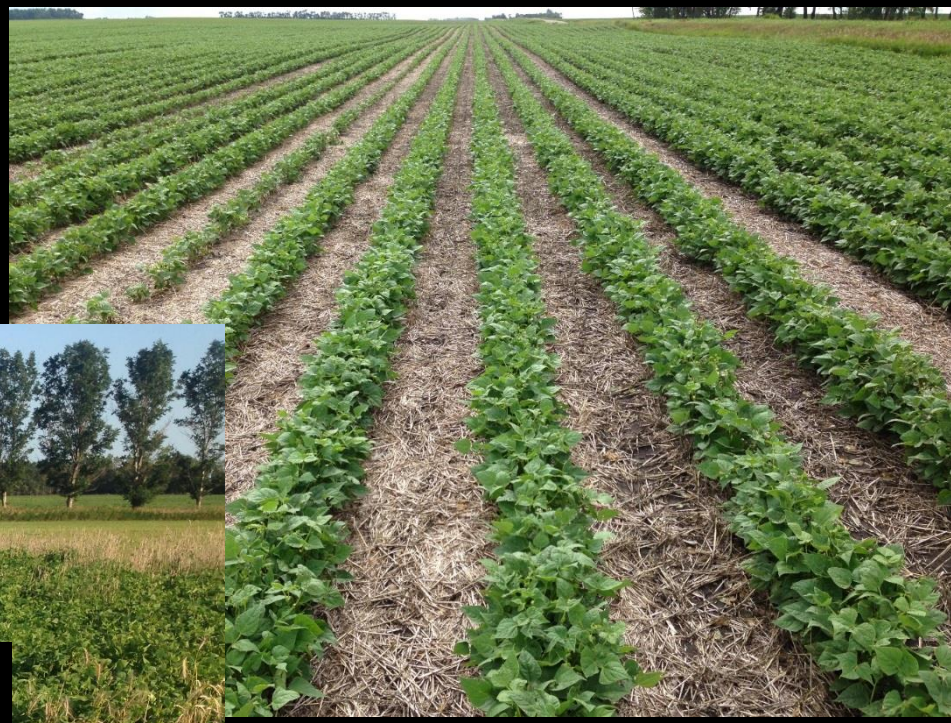


pp. 12-13;
tables 15-18

- 20% respondents used cover crops on dry bean fields
  - ✓Reasons for cover crop use
    1. Soil conservation (96%)
    2. Weed control (11%)

Northarvest	Number	%
Cereal grass species only (barley, oats, rye)	34	72.3
Broadleaf species only (clover, pea, radish, turnip)	1	2.1
Cereal grass + broadleaf species	12	25.5

Winter rye cover crop for pinto bean



Bean yield?
Rye termination timing?
Weed suppression?

NORTHARVEST BEANS
MINNESOTA
NORTH DAKOTA

Factors impacting pinto bean seed yield during rye with pinto bean study, Carrington, 2017-19

2017

- Rain/soil moisture
  - dry May and July
- High rye plant density

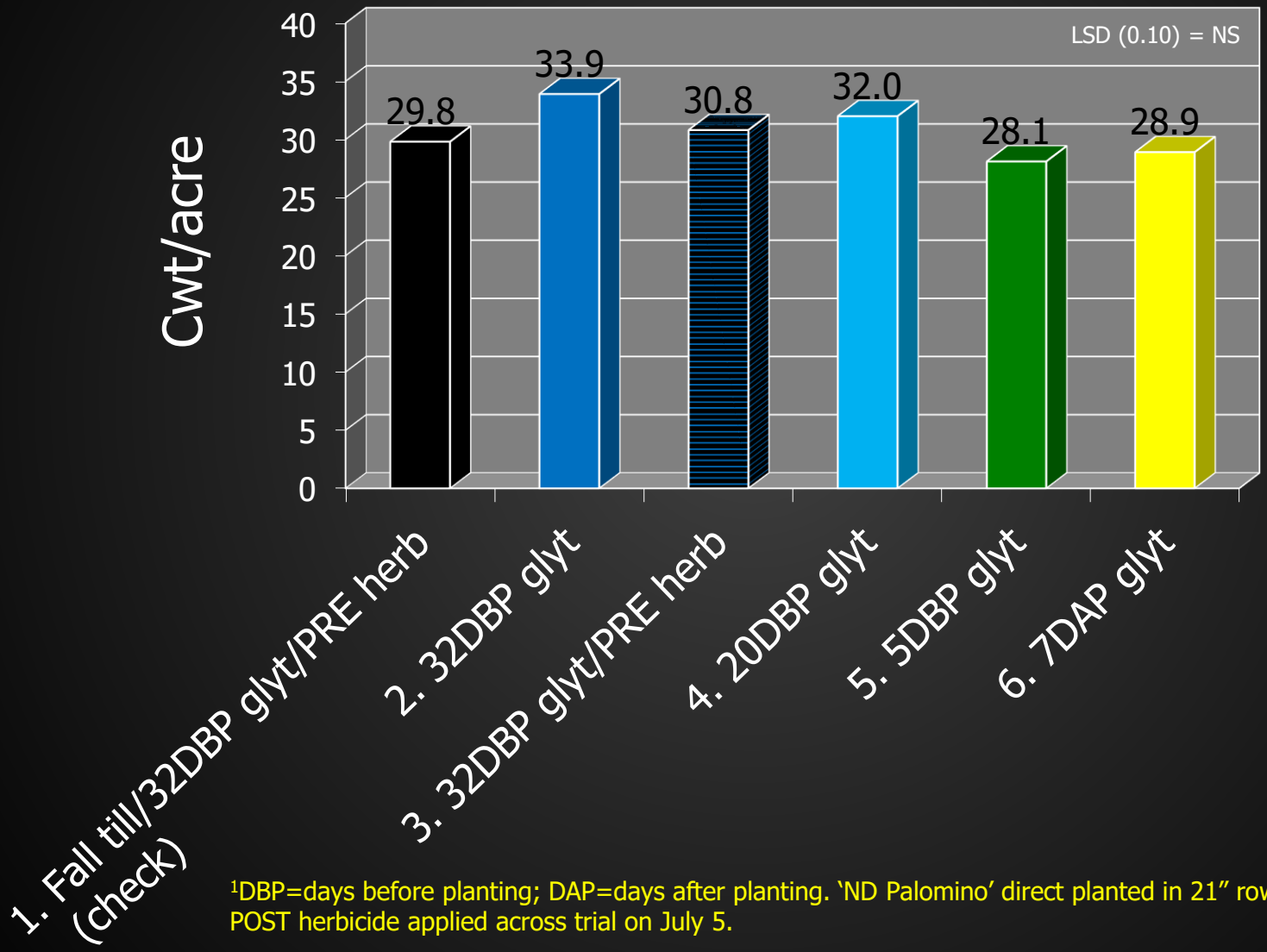
2018

- Rain/soil moisture
  - dry May and mid-July to mid-September
- Marginal rye plant density
- High foxtail density

2019

- Rain/soil moisture
  - dry May through first-half June

Pinto bean yield among rye termination treatments, Carrington, 2019[1]



[1]DBP=days before planting; DAP=days after planting. 'ND Palomino' direct planted in 21" rows on June 3. POST herbicide applied across trial on July 5.

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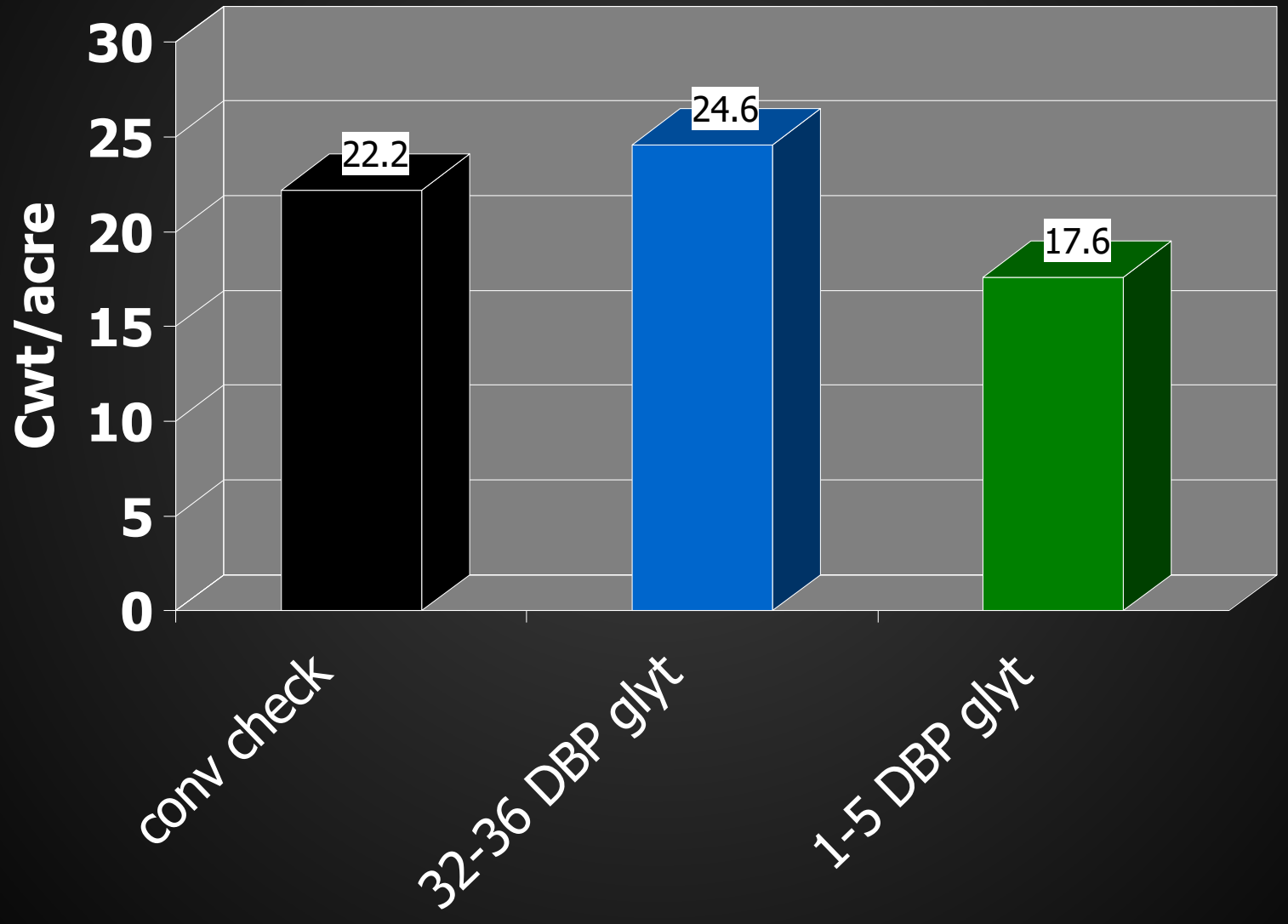
Pinto bean yield with conventional check, and early and late spring termination of rye, Carrington, 2017-19 (3 site-years)



Agronomic notes, 2017-19

- Pinto bean can yield well with rye as a cover crop
  - Terminate rye before bean planting
    - closely monitor early season soil moisture
    - >2-3 weeks before bean planting during 'dry' spring
  - Established less than targeted crop stand
    - trial average 48,700-62,300 plants/acre

Planting Date

Is there a seed yield or quality advantage by planting dry bean earlier than normal?

- Pinto: 6 trials
- Black: 3 trials
- Navy: 2 trials

Table 3. Dry bean yield response to planting dates during early crop seasons, Carrington and Prosper, 2012 and 2015.

		Seed yield (cwt/acre)		
		Planting period[2]		
Market type/variety	Trial number[1]	Early	Normal	Late
Pinto/Lariat	4	22.4	22.7	23.7
Navy/Avalanche	1	12.2	16.1	15.5
Black/Eclipse	2	22.0	21.5	19.2
average		18.9	20.1	19.5

[1]Pinto: Carrington=2012 (2 trials) and 2015; Prosper=2012. Navy: Carrington=2014-15; Black: Carrington=2012, 2014-15.

[2]Early: May 11-17; Normal: May 22-30; Late: June 5-13.

No advantage with early planting for plant lodging, seed size, seed quality, etc.

In summary, the NDSU dry bean research conducted during four years, including two years each of crop seasons with early and late crop planting start times, with three market types planted during early, normal and late planting dates indicates the normal planting period (last 10 days of May through first week of June) used by farmers remains viable.

A1806

Impact of Planting Dates on Dry Edible Bean

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The 2012 crop season in North Dakota began early, providing the opportunity to plant crops in a timely manner and plant some crops, including dry edible bean (*Phaseolus vulgaris* L.), earlier than normal. This prompted North Dakota State University researchers to conduct field trials to explore if dry bean seed yield and quality can be increased with early planting, compared with the normal planting period (the last 10 days of May through the first 10 days of June) or a late period.

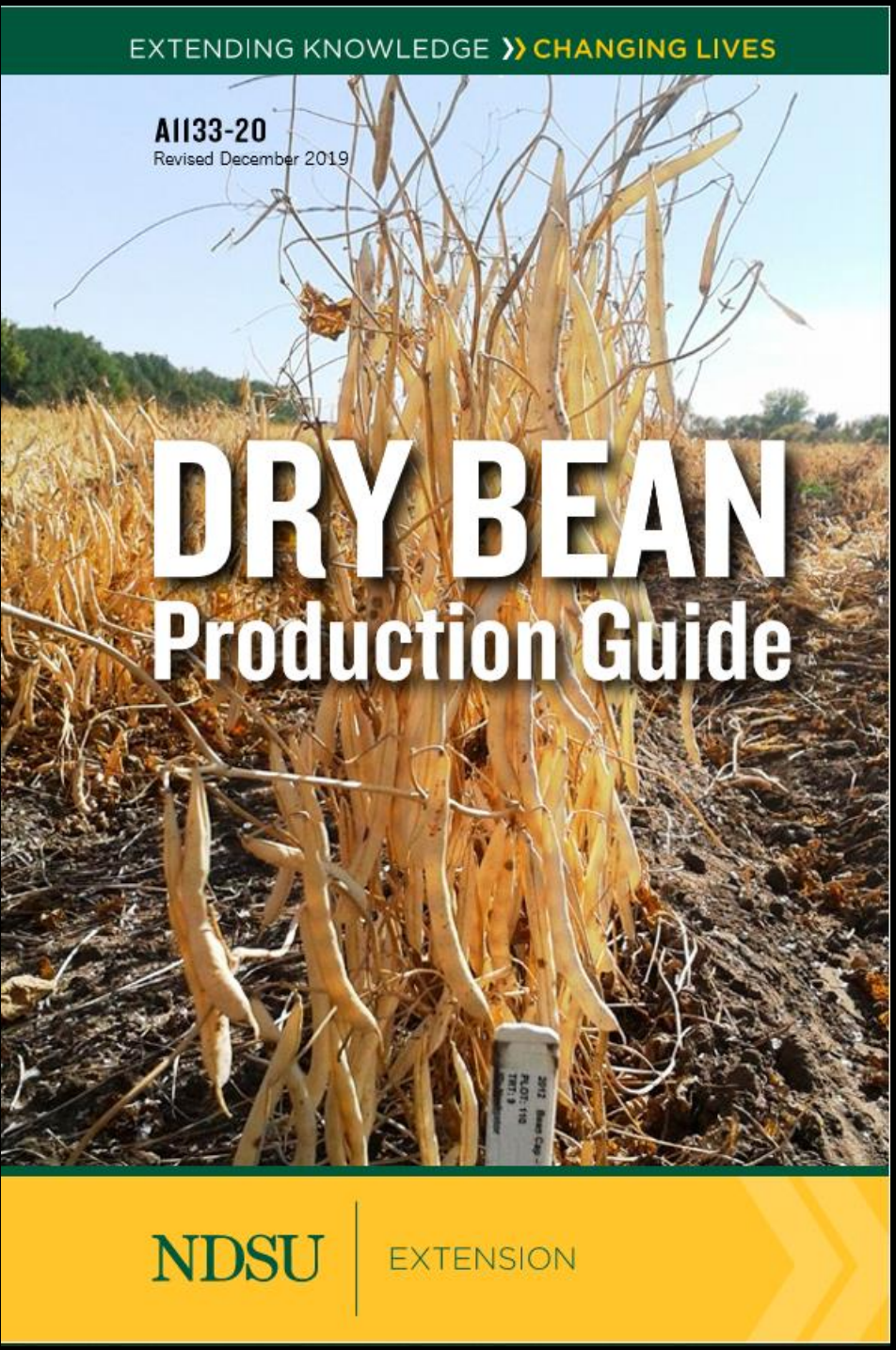
If so, early planting would provide the opportunity to increase profitability without additional input costs. This publication will summarize results of NDSU dry bean planting date trials conducted during 2012 through 2015.

NDSU EXTENSION SERVICE

May 2016

(Cover photo by Greg Endres, NDSU)

Net search:
'NDSU dry bean planting dates'



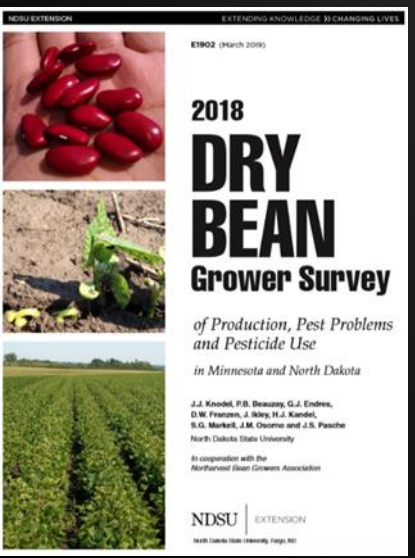
pp. 14-17

Table 7. Recommended plant populations for specialty market classes.

Market class	Plant population (plants per acre)
Black	90,000-120,000
Cranberry	65,000-80,000
Great Northern	70,000-80,000
Kidney	70,000-90,000
Navy	90,000 (wide rows); greater than 115,000 (narrow rows)
Pink	70,000
Pinto	70,000-80,000
Small Red	70,000-90,000

Black, Navy and Pinto Bean: **Row Spacing and Plant Population**

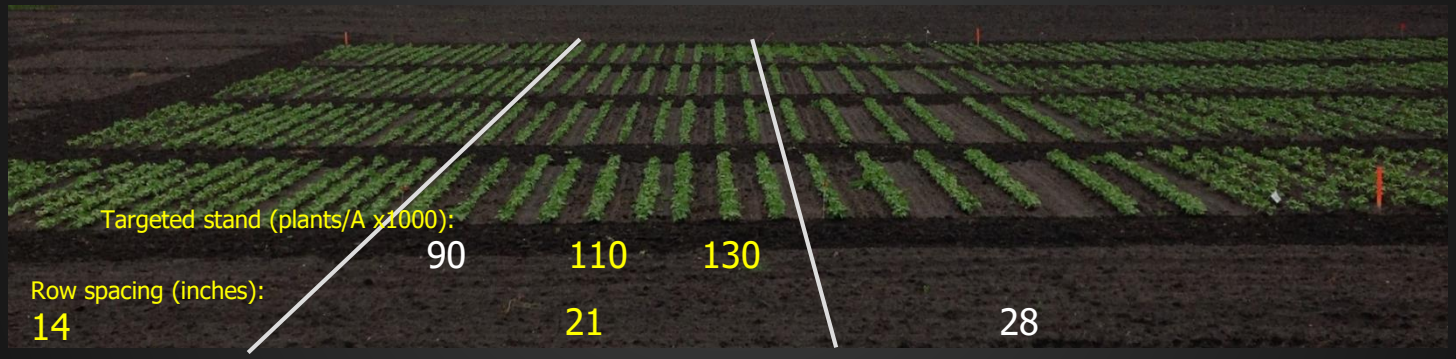
Can seed yield be economically increased by planting in narrow rows with more dense plant stands than current NDSU recs?



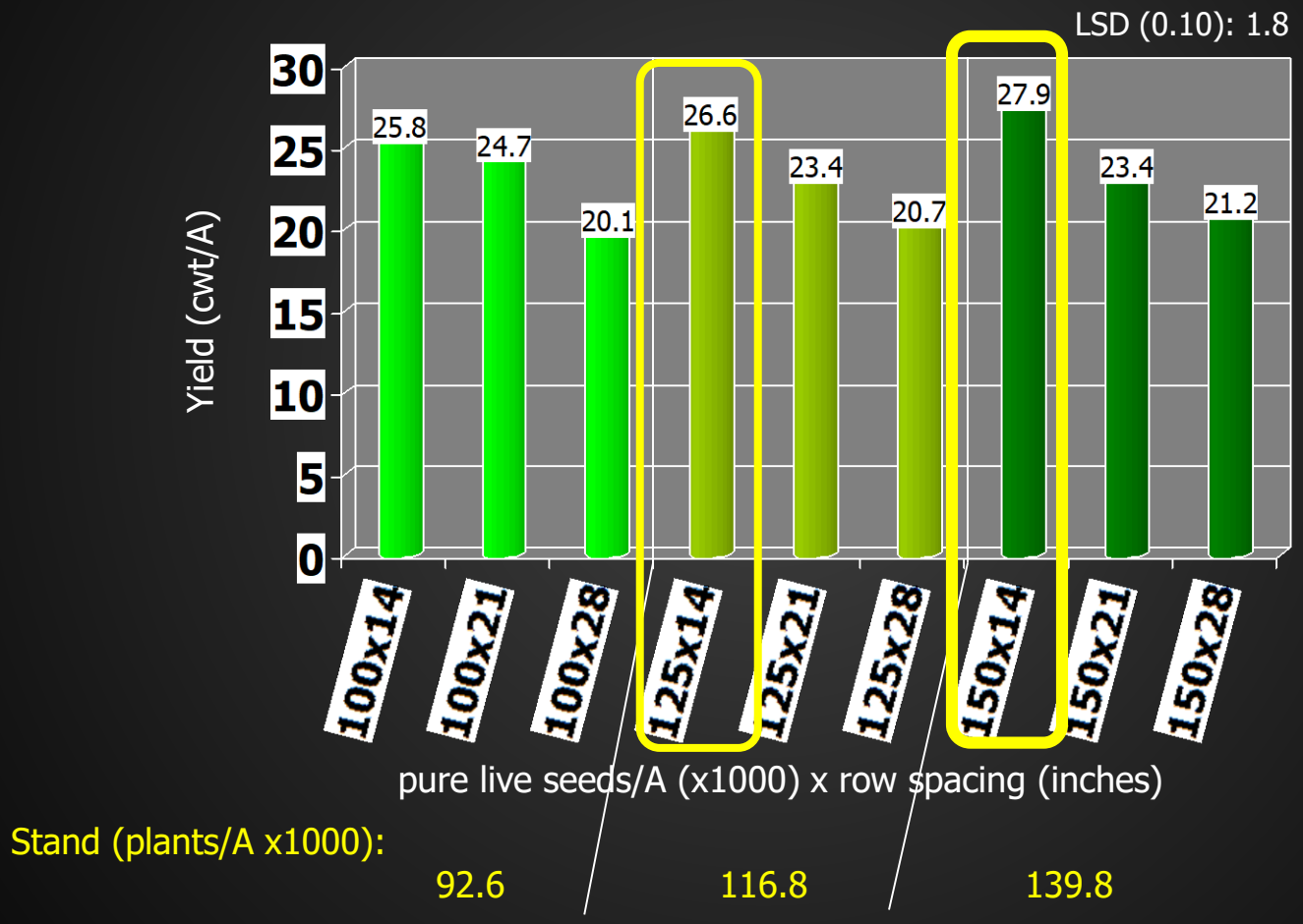
p. 10;
tables 10-11

NORTHARVEST BEANS
MINNESOTA
NORTH DAKOTA

Black and navy bean response to **row spacing by plant population**, Carrington, 2014-18



Navy bean seed yield with three row spacings and three plant populations, Carrington, 2014 and 2016-17 (3 site-years)



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A1921

Black and Navy Bean

Response to Row Spacing and Plant Population in Eastern North Dakota

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Narrower row spacings and higher plant populations are trending in dry bean production. Data from a 2018 dry bean grower survey (Knodel et al. 2019) indicate 39% of black and 44% of navy bean were planted in North Dakota at rates of 110,000 seeds per acre or greater, with the likely goal of establishing at least 100,000 plants per acre. In addition, the survey results record about 70% of black and navy bean in 2018 were planted in row widths ranging from 11 to 25 inches.

Based on historic North Dakota work, NDSU recommends an established stand of 90,000 plants per acre for black and navy bean. Research conducted in 1999 to 2000 indicated no seed yield response among black and navy bean planting rates of 90,000, 105,000 and 120,000 pure live seeds (PLS) per acre and a yield increase in one of two years with 7- versus 30-inch row spacings (Schatz et al. 2000).

This publication summarizes NDSU research trials conducted 2014 to 2018 in eastern North Dakota to evaluate potential yield increase of black and navy bean with higher plant populations and narrower rows compared to the traditionally recommended plant density in wide rows.

NDSU EXTENSION

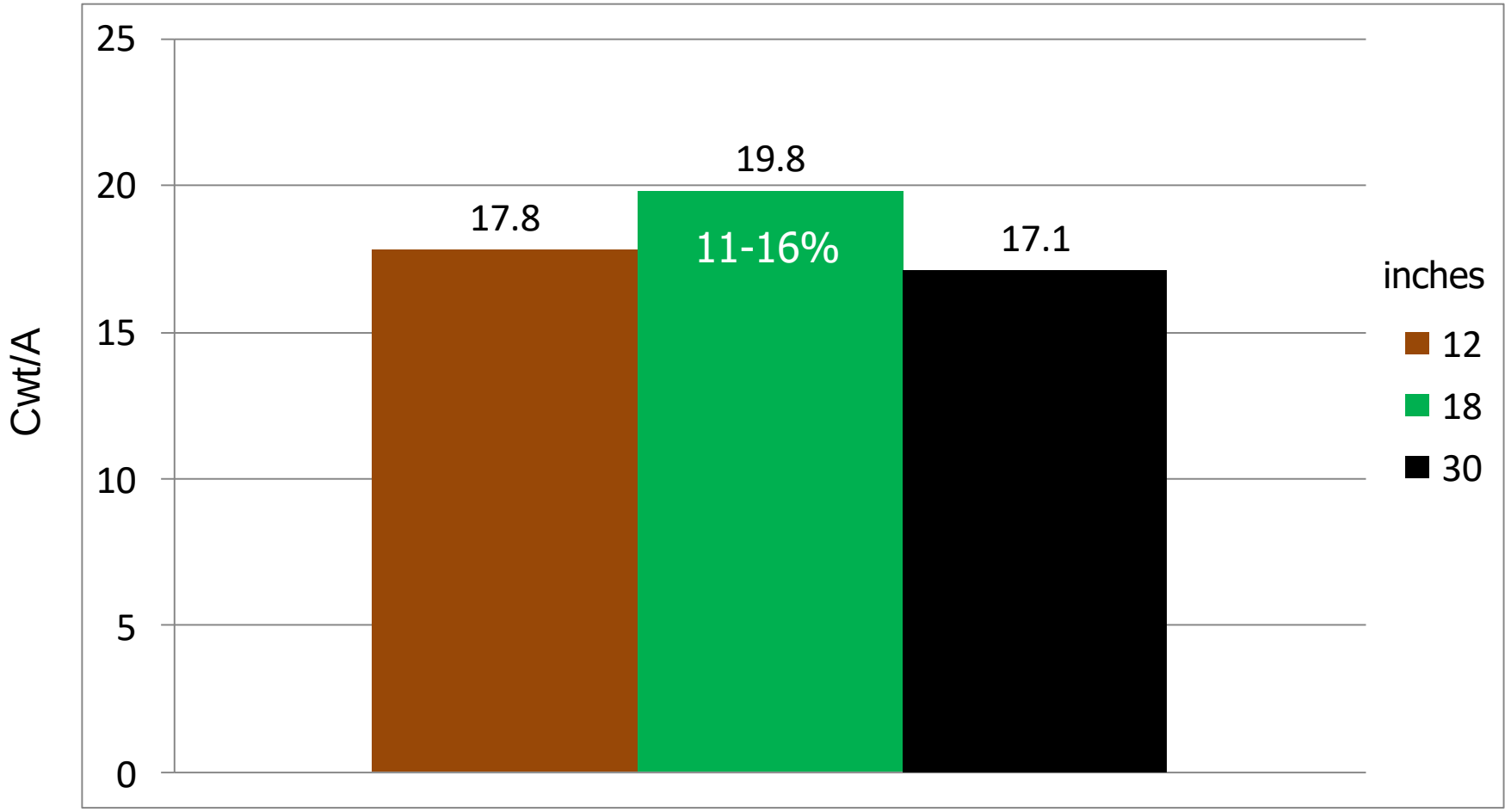
North Dakota State University, Fargo, North Dakota
May 2019

Summary

Black bean seed yield was similar among the three row spacings. The high plant population (slightly more than 140,000 plants per acre) increased yield 3% compared to the low population (slightly less than 100,000 plants per acre).

Narrow (14-inch) rows with navy bean plant populations of greater than 115,000 plants per acre increased yield 24% to 28% compared to wide rows with slightly more than 90,000 plants per acre.

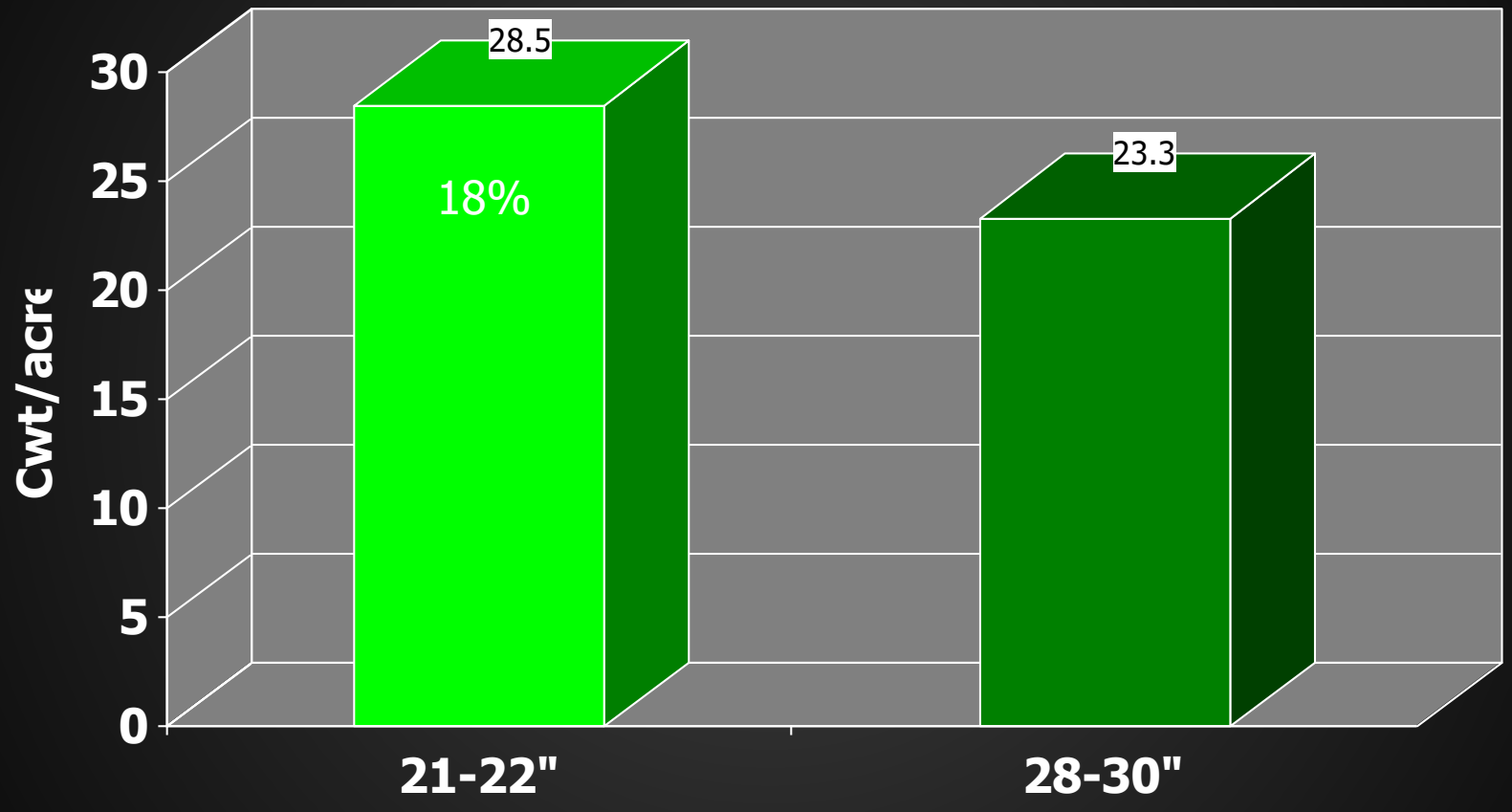
Pinto bean yield response to row spacing, eastern ND, 2008-09 (4 site-years)*



*Carrington, Hatton and Prosper. Means averaged across varieties, N levels and harvest methods.

Kandel, Osorno et al.

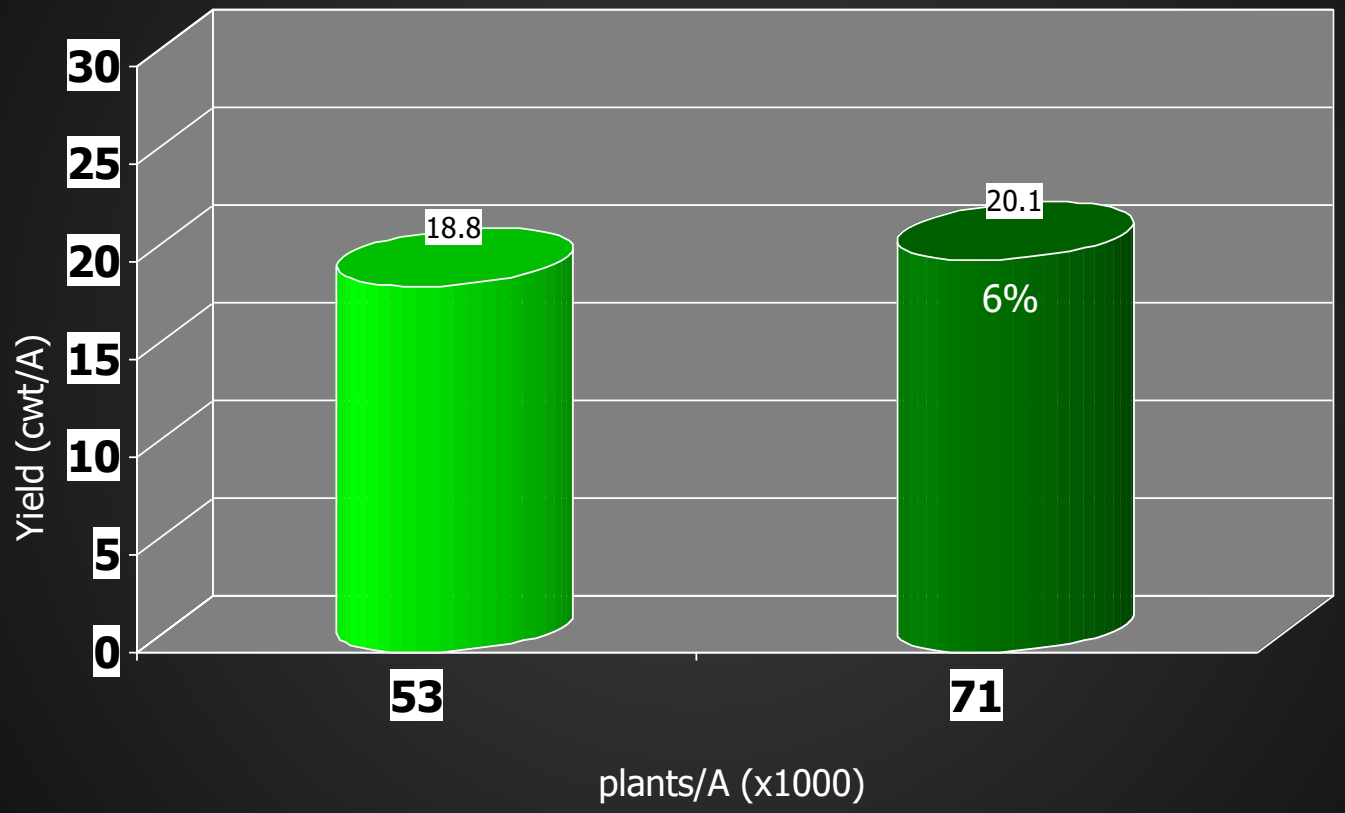
Pinto bean seed yield between row spacings, Carrington, 2011-13 and 2018-19 (5 site-years)*



*'Lariat': 2011-13; 'ND Palomino': 2018-19. Averaged across tillage systems and fertilizer treatments (2011-13) and plant populations (2018-19). LSD (0.10): significant each year.

G. Endres et al.

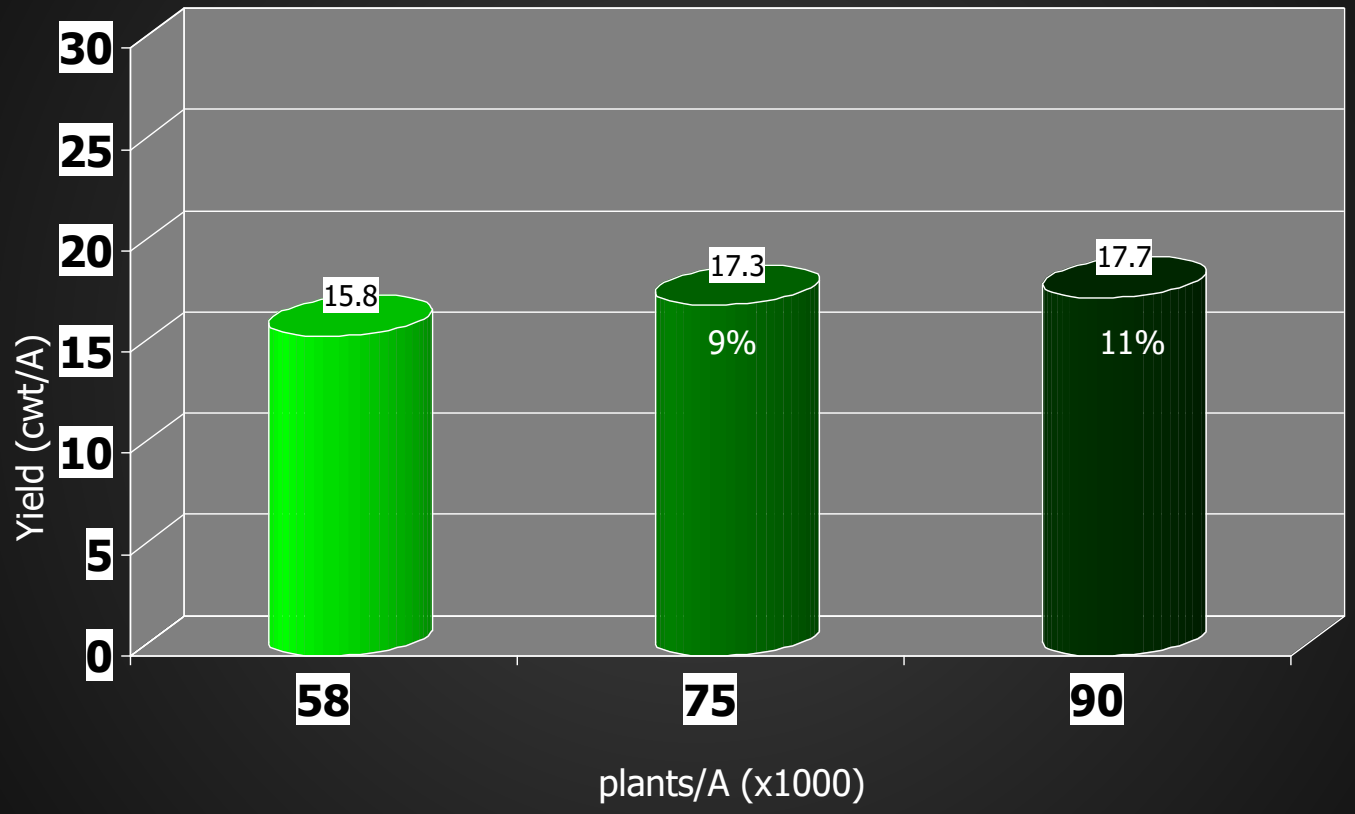
Pinto bean seed yield between **plant populations,** Carrington, 2013 and 2018-19; and Minot, 2019 (4 site-years)*



*2013: 'Lariat'; 2018-19: 'ND Palomino'. Carrington: Averaged across planting dates (2013) and row spacings (2018-19); LSD: 2013 (0.05) = NS; 2018-19 (0.10) = *. Minot: Averaged across row spacings and planting techniques; LSD (0.05): NS.

G. Endres, E. Eriksmoen et al.

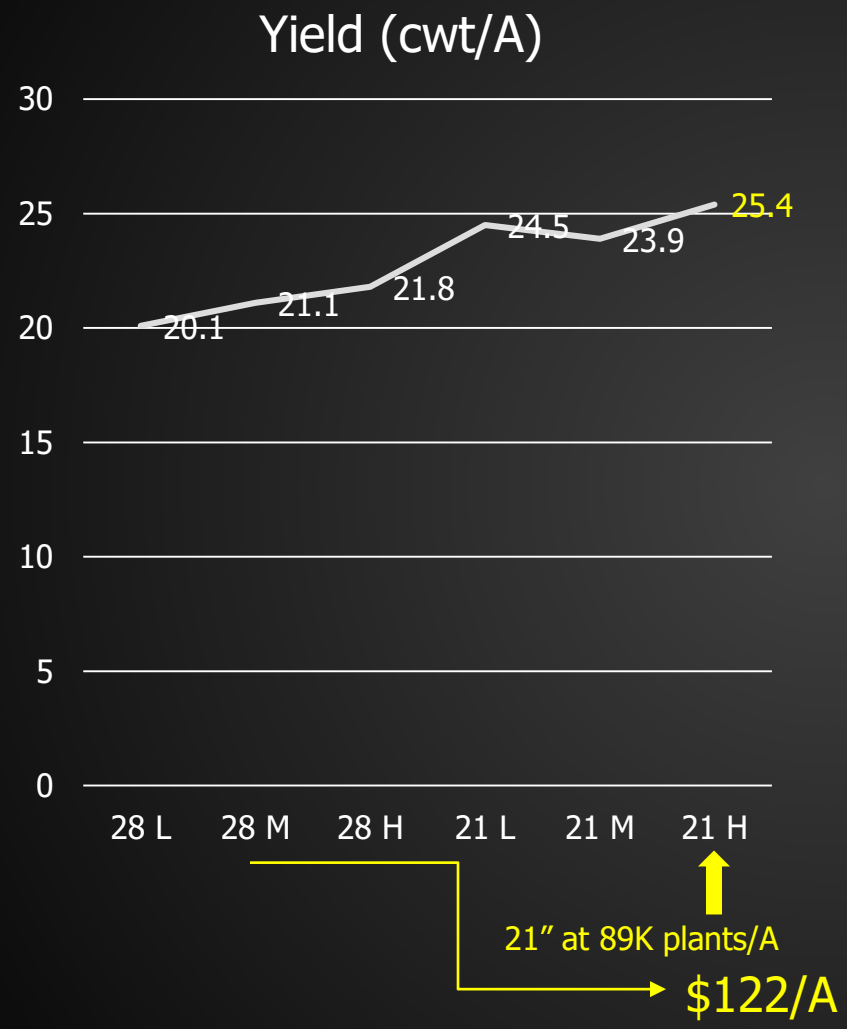
Pinto bean seed yield among **plant populations**, Carrington, 2013 and 2018 (2 site-years)*



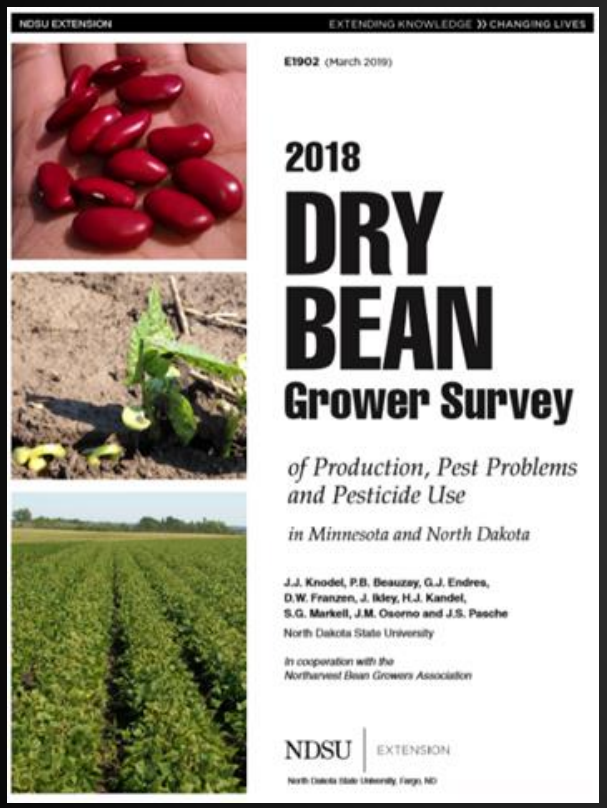
*2013: 'Lariat'; 2018: 'ND Palomino'. Averaged across planting dates (2013) and row spacings (2018).
LSD: 2013 (0.05) = NS; 2018 (0.10) = *.

G. Endres et al.

Pinto bean response to **row spacing and plant population,** Carrington, 2018-2019 (2 site-yr)*

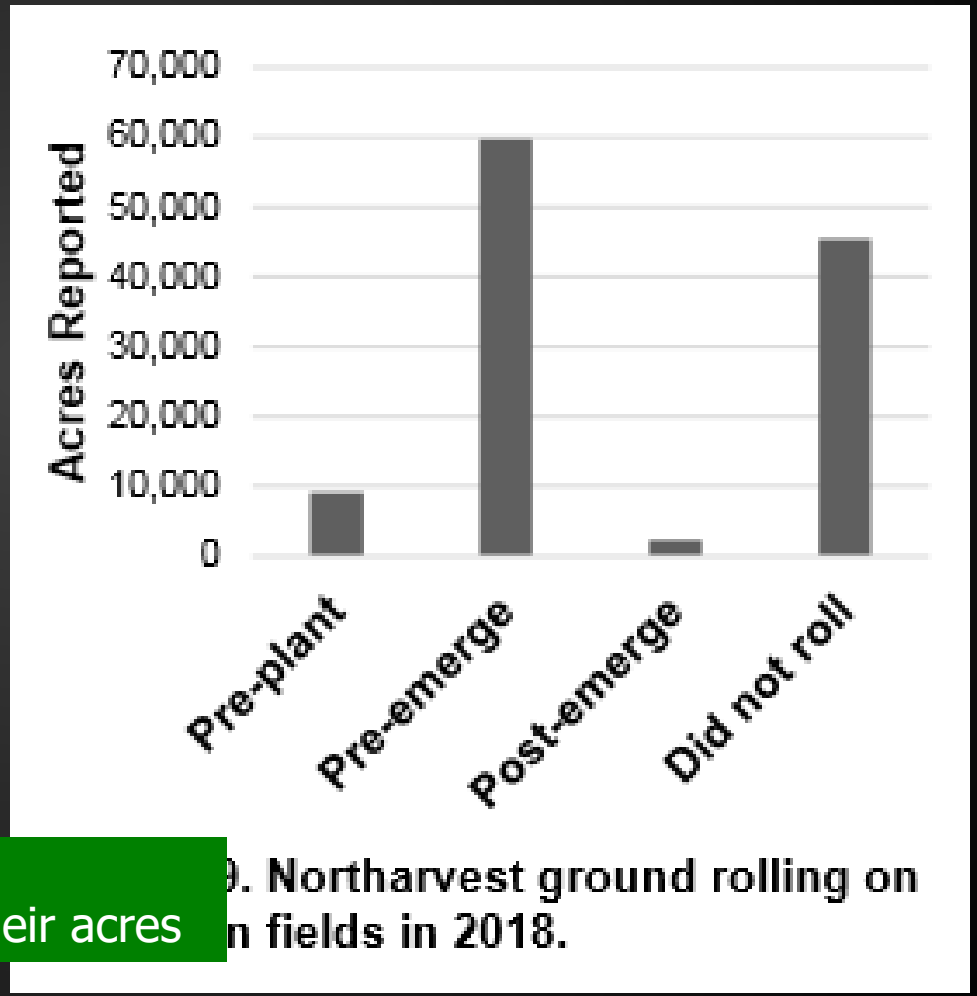


Ground Rolling



p. 14;
tables 19-20

8 51 2 39 %



. Northarvest ground rolling on
n fields in 2018.

99% of respondents that ground rolled also direct combined at least a part of their acres

Table 2: Plant and Soil Response as Measured in the Dry Bean Field Rolling Trial, Arborg, MB 1999

Treatment [a]	Yield (lbs/acre)	Plants /m² (#)	Damaged Plants/m² (#)	0-5 cm Bulk Density (g/cm³)	5-10cm Bulk Density (g/cm³)	10-15cm Bulk Density (g/cm³)
No Rolling	3040	63	0	0.82	1.06	1.06
Rolling prior to emergence	3000	63	0	0.91	1.17	1.18
Rolling 7 days after emerg.	3100	63	2.4	0.93	1.11	1.16
Mean	3047	63	1	0.88	1.11	1.13
C.V. (%)[b]	11.53	12.9	134.16	8.61	4.57	4.79
LSD (0.05)[c]	ns	ns	1.5	ns	ns	ns

[a] *The rolling was conducted using a 12.2 metre wide Begelman Industries field roller. The empty weight was 6,125 kg giving a pressure of 5.0kg/cm of roller.*

[b] *Coefficient of Variation - the variation in the data for which the source is unknown. Expressed as a percentage of the overall mean.*

[c] *Least Significant Difference. Any two means in the column that differ by more than this value are are considered significantly different with a confidence level of 95 percent. "ns" indicates that the differences are not statistically significant.*

Summary

- Dry bean yield can be maintained with reduced till system while realizing the soil benefits
- Seed yield can be maintained with winter rye as a cover crop before dry bean with proper management while realizing the cover crop benefits
- When early planting is possible, research has indicated no seed yield or quality benefits vs. normal planting period
- Seed yield increase with rows and population
  - row spacing: navy = 12-15 (14)"; pinto = 18-22"
  - population: navy (and black) = ≥ 115,000 plt/A; pinto = ≥ 70,000 plt/A
- PRE ground rolling is proper timing

Questions?